

AMENDMENTS TO THE CLAIMS:

1. (Currently amended) An apparatus for driving a liquid crystal display, said display comprising an array of elongated row and an array of elongated column electrodes arranged transverse to the row electrodes, wherein overlapping areas of the two arrays of electrodes define pixels of the display when viewed in a viewing direction, said apparatus comprising:

at least two separate power sources; and

a circuit responsive to the at least two power sources and supplying electrical potentials to the row and column electrodes, to cause the display to display desired images, wherein at least one of the electrical potentials supplied to the row and column electrodes ~~floats~~changes with a voltage supplied or caused to be supplied by one of the power sources, said circuit comprising two energy storage devices, wherein the devices are charged by one of the power sources during a portion of at least one field addressing cycle and used to supply electrical potentials to a row or column electrode in a different portion of such field addressing cycle, wherein the devices are charged for a fraction of such different portion to compensate for charge consumption.

2. (Currently and Previously Amended) The apparatus of claim 1, the circuit comprising a control device and at least one energy storage device to supply said at least one of the electrical potentials, wherein the control device causes the at least one energy storage device to be charged in a first phase, and connects said at least one energy storage device to the voltage supplied or caused to be supplied by said one of the power sources and to the row or column electrodes in a later second phase, so that said at least one of the electrical potentials supplied by said at least one energy storage device to the row or column electrodes ~~floats~~changes with said voltage.

3. (Currently amended) The apparatus of claim 2, wherein at least one energy storage device has at least two terminals, wherein the control device causes one terminal to be connected to the voltage and another terminal to be connected to the row and column electrodes, wherein said another terminal supplies said at least one of the electrical potentials that ~~floats~~changes with the voltage.

4. (Previously Amended) The apparatus of claim 2, the at least one energy storage device comprising one or more capacitors.

5. (Original) The apparatus of claim 2, wherein the control device also causes the at least one energy storage device to supply electrical potentials to the row or column electrodes during the first phase.

6. (Original) The apparatus of claim 2, said at least two power sources supplying respectively a first and a second voltage and a common reference voltage, the difference between the second and the reference voltages defining a voltage differential, said control device comprising a first set of switches that causes a set of voltages to be generated that are above the reference voltage or below the first voltage by an integer multiple of the voltage differential.

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7. (Original) The apparatus of claim 6, said control device further comprising a second set of switches that connect said set of voltages at selected times to the row and column electrodes so that the electrodes are driven by an IAPT driving method.

8. (Currently amended) The apparatus of claim 6, wherein some of the voltages in the set of voltages float-change with the reference voltage during some field addressing cycles and other voltages in the set of voltages float-change with the first voltage during other field addressing cycles.

9. (Previously Amended) The apparatus of claim 2, said circuit comprising two energy storage devices each having two terminals, wherein the control device causes the two energy storage devices to be connected in parallel to the power sources during the first phase to charge the energy storage devices, so that they are charged to substantially the same voltage across their terminals.

10. (Previously Amended) The apparatus of claim 2, said circuit comprising two energy storage devices each having two terminals, wherein the control device causes

the two energy storage devices to be connected in series to the power source during the first phase to charge the energy storage devices.

11. (Original) The apparatus of claim 2 wherein the electrical potentials supplied by the circuit to the row electrodes are of a predetermined amplitude above a reference voltage in some field addressing cycles and of the predetermined amplitude below the reference voltage in other field addressing cycles, wherein the electrical potentials supplied by the circuit have a dynamic range substantially equal to said amplitude.

12. (Cancelled)

13. (Original) The apparatus of claim 1, said apparatus being an integrated circuit having a substrate, wherein the first and second power sources supply only electrical potentials that are higher or lower than a reference potential of the substrate.

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14. (Currently amended) An apparatus for driving a liquid crystal display, said display comprising an array of elongated row and an array of elongated column electrodes arranged transverse to the row electrodes, wherein overlapping areas of the two arrays of electrodes define pixels of the display when viewed in a viewing direction, said apparatus comprising:

at least two separate power sources;

wherein one or more of the power sources drives the row electrodes through a first voltage range, and drives the column electrodes through a second voltage range, wherein the first voltage range changes over different field addressing cycles, and the second voltage range ~~floats~~changes with the first voltage range when the first voltage range changes and with at least the voltage generated or caused to be generated by one of the power sources.

15. (Currently amended) The apparatus of claim 14, wherein the first voltage range is between a non-scanning voltage value and a scanning voltage value, and wherein the second voltage range ~~floats~~changes with the non-scanning voltage value.

16. (Currently and Previously Amended) The apparatus of claim 15, wherein the first power source comprises a first power supply, wherein the second power source comprises a pair of capacitors, said apparatus further comprising a switching circuit connecting the first power supply and the capacitors to cause the second voltage range to ~~float~~ change about the non-scanning voltage value.

17. (Original) The apparatus of claim 16, wherein the pair of capacitors are connected in a voltage divider configuration separating three nodes, wherein the switching circuit causes one of the nodes in between the pair to be at the non-scanning voltage of the first voltage range in at least one field addressing cycle.

18. (Currently amended) The apparatus of claim 17, wherein the switching circuit causes voltages at one of the two remaining nodes to be supplied to ~~a connections~~ a column electrode during at least one field addressing cycle.

19. (Original) The apparatus of claim 15, wherein the capacitors are charged by the first or second power source during a portion of at least one field addressing cycle and used to supply electrical potentials to a row or column electrode in a different portion of such field addressing cycle, wherein the capacitors are charged for a fraction of such different portion to compensate for charge consumption.

20. (Currently amended) The apparatus of claim 19, wherein the column electrodes are driven by column drivers, and wherein the column electrodes are substantially disconnected from column drivers during said fraction of such different portion to preserve column signals that have been applied to the column electrodes so that a desired image is displayed at pixels covered by the column electrodes that are substantially disconnected from the column drivers.

21. (Original) The apparatus of claim 14, said apparatus being an integrated circuit having a substrate, wherein the first and second power sources supply only electrical potentials that are higher or lower than a reference potential of the substrate.

22. (Previously Amended) The apparatus of claim 14, one of the power sources comprising at least one power supply and a capacitor, said capacitor connected to a connection node for each of the column electrodes and storing charges from a column electrode during one column addressing cycle, said second power source further comprising a switching circuit that cause said stored charges to be applied to said column electrode in a subsequent column addressing cycle.

23. (Cancelled)

24. (Cancelled)

25. (Currently amended) A method for driving a liquid crystal display, said display comprising an array of elongated row and an array of elongated column electrodes arranged transverse to the row electrodes, wherein overlapping areas of the two arrays of electrodes define pixels of the display when viewed in a viewing direction, said method comprising

supplying electrical potentials to the row and column electrodes, to cause the display to display desired images by connecting a power supply and at least one column electrode to a first and a second electrical energy storage device so that in one row scanning cycle, the first device is connected to the power supply to charge the first device and the second device is connected to the at least one column electrode to apply to it an electrical potential, and in another row scanning cycle, the second device is connected to the power supply to charge the second device and the first device is connected to the at least one column electrode to apply to it an electrical potential;

wherein said supplying connects the power supply and the at least one column electrode to the two energy storage devices according to a switching timing waveform that is delayed relative to said row scanning cycles, so that at least one of the energy storage devices is connected to the at least one column electrode during a portion of a row scanning cycle, and the remaining energy storage device is connected to the at least one column electrode during another portion of such row scanning cycle~~wherein said supplying comprises charging and discharging at least one energy storage device to supply said at least one of the electrical potentials.~~

26. (Currently and Previously Amended) The method of claim 25, wherein at least one of the electrical potentials supplied to the row or column electrodes by one of the devices changes floats with a voltage supplied by a power source, ~~wherein said supplying includes charging the at least one energy storage device in a first phase, and connects said at least one energy storage device to the row or column electrodes in a later second phase, so that said at least one of the electrical potentials supplied by said at least one energy storage device to the row or column electrodes floats with said voltage.~~

27. (Currently amended) The method of claim 26, wherein said at least one of the energy storage devices has at least two terminals, wherein the supplying causes one terminal to be connected to the voltage and another terminal to be connected to the row and column electrodes, and causes said another terminal to supply said at least one of the electrical potentials that changes floats with the voltage.

28. (Original) The method of claim 25, wherein said supplying comprises connecting an energy storage device alternately to a power supply and at least one column electrode.


29. (Currently amended) The method of claim 28, said supplying comprising connecting the power supply and the at least one column electrode to at the first and a second electrical energy storage devices in alternate row scanning cycles.

30. (Cancelled)

31. (Currently amended) The method of claim ~~25~~³⁰, wherein said time delay is such that a major portion of the energy of the first energy storage device is transferred to the at least one column electrode during a beginning portion of such row scanning cycle, thereby driving the voltage of said at least one column electrode to close to a target value, and a minor portion of the energy of the second energy storage device is transferred to the at least one column electrode during such row scanning cycle but after the beginning portion of such row scanning cycle, thereby driving the voltage of said at least one column electrode to substantially the target value.

32. (Currently amended) The method of claim 2530, wherein said switching timing waveform is such that during a portion of such row scanning cycle, both the first and the second energy storage devices are connected to the at least one column electrode.

33. (Currently amended) A method for driving a liquid crystal display, said display comprising an array of elongated row and an array of elongated column electrodes arranged transverse to the row electrodes, wherein overlapping areas of the two arrays of electrodes define pixels of the display when viewed in a viewing direction, said method comprising

 supplying electrical potentials to the row and column electrodes, to cause the display to display desired images by connecting a power supply and at least one column electrode to a first and a second electrical energy storage device so that in one row scanning cycle, the first device is connected to the power supply to charge the first device and the second device is connected to the at least one column electrode to apply to it an electrical potential, and in another row scanning cycle, the second device is connected to the power supply to charge the second device and the first device is connected to the at least one column electrode to apply to it an electrical potential;

~~The method of claim 29,~~ wherein the first energy storage drives the voltage of said at least one column electrode to close to a target value during a beginning portion of a row scanning cycle, and the second energy storage device drives the voltage of said at least one column electrode to substantially the target value during such row scanning cycle but after the beginning portion of such row scanning cycle.

34. (Currently amended) The method of claim 33, wherein a major portion of the energy of the first energy storage device is transferred to the at least one column electrode during a beginning portion of a row scanning cycle, thereby driving the voltage of said at least one column electrode to close to a target value, and a minor portion of the energy of the second energy storage device is transferred to the at least one column electrode during such row scanning cycle but after the beginning portion of such row scanning cycle, thereby driving the voltage of said at least one column electrode to substantially the target value.

35. (Currently Amended) The method of claim 3329, wherein during a portion of a row scanning cycle, both the first and the second energy storage devices are connected to the at least one column electrode.

36. (Currently Amended) An apparatus for driving a liquid crystal display, said display comprising an array of elongated row and an array of elongated column electrodes arranged transverse to the row column electrodes, wherein overlapping areas of the two arrays of column electrodes define pixels of the display when viewed in a viewing direction, said apparatus comprising:

a power supply;

a first and a second at least one electrical energy storage device; and

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a switching circuit connecting the power supply to the devices to charge the devices and connecting the devices to at least one of the column electrodes to supply electrical potential(s) thereto, so that in one row scanning cycle, the first device is connected to the power supply to charge the first device and the second device is connected to the at least one column electrode to apply to it an electrical potential, and in another row scanning cycle, the second device is connected to the power supply to charge the second device and the first device is connected to the at least one column electrode to apply to it an electrical potential, wherein said circuit connects the power supply and the at least one column electrode to the two energy storage devices according to a switching timing waveform that is delayed relative to said row scanning cycles, so that at least one of the energy storage devices is connected to the at least one column electrode during a portion of a row scanning cycle, and the remaining energy storage device is connected to the at least one column electrode during another portion of such row scanning cycle and wherein the display displays desired images.

37. (Previously Amended) The apparatus of claim 36, wherein said power supply comprises a voltage regulator, a comparator and a current source.

38. (Original) The apparatus of claim 36, wherein said circuit connects the device alternately to the power supply and the at least one column electrode.

39. (Original) The apparatus of claim 36, said apparatus comprising a first and a second electrical energy storage device, wherein said circuit connects the power supply and the at least one column electrode to the two energy storage devices in alternate row scanning cycles.

40. (Cancelled)

41. (Currently amended) The apparatus of claim 3640, wherein said time delay is such that a major portion of the energy of the first energy storage device is transferred to the at least one column electrode during a beginning portion of such row scanning cycle, thereby driving the voltage of said at least one column electrode to close to a target value, and a minor portion of the energy of the second energy storage device is transferred to the at least one column electrode during such row scanning cycle but after the beginning portion of such row scanning cycle, thereby driving the voltage of said at least one column electrode to substantially the target value.

42. (Currently amended) The apparatus of claim 3640, wherein said switching timing waveform is such that during a portion of such row scanning cycle, both the first and the second energy storage devices are connected to the at least one column electrode.

43. (Currently amended) An apparatus for driving a liquid crystal display, said display comprising an array of elongated row and an array of elongated column electrodes arranged transverse to the row column electrodes, wherein overlapping areas of the two arrays of column electrodes define pixels of the display when viewed in a viewing direction, said apparatus comprising:

a power supply;

a first and a second electrical energy storage device; and

a switching circuit connecting the power supply to the devices to charge the devices and connecting the devices to at least one of the column electrodes to supply electrical potential(s) thereto, so that in one row scanning cycle, the first device is connected to the power supply to charge the first device and the second device is connected to the at least one column electrode to apply to it an electrical potential, and in

another row scanning cycle, the second device is connected to the power supply to charge the second device and the first device is connected to the at least one column electrode to apply to it an electrical potential. ~~The apparatus of claim 39, wherein the first energy storage device drives the voltage of said at least one column electrode to close to a target value during a beginning portion of a row scanning cycle, and the second energy storage device drives the voltage of said at least one column electrode to substantially the target value during such row scanning cycle but after the beginning portion of such row scanning cycle.~~

44. (Currently amended) The apparatus of claim 43, wherein a major portion of the energy of the first energy storage device is transferred to the at least one column electrode during a beginning portion of a row scanning cycle, thereby driving the voltage of said at least one column electrode to close to a target value, and a minor portion of the energy of the second energy storage device is transferred to the at least one column electrode during such row scanning cycle but after the beginning portion of such row scanning cycle, thereby driving the voltage of said at least one column electrode to substantially the target value.

45. (Currently amended) The apparatus of claim ~~43~~39, wherein during a portion of a row scanning cycle, both the first and the second energy storage devices are connected to the at least one column electrode.

46. (New) The apparatus of claim 1, wherein said circuit supplies electrical potentials to the row and column electrodes according to periodic addressing cycles of the liquid crystal display, and said change of at least one of the electrical potentials supplied to the row and column electrodes occurs in a predetermined timing relationship to the addressing cycles.

47. (New) The apparatus of claim 14, wherein the one or more power sources drives the row and column electrodes according to periodic addressing cycles of the liquid crystal display, and said changes of the first and second voltage ranges occur in a predetermined timing relationship to the addressing cycles.

48. (New) An apparatus for driving a liquid crystal display, said display comprising an array of elongated row and an array of elongated column electrodes arranged transverse to the row electrodes, wherein overlapping areas of the two arrays of electrodes define pixels of the display when viewed in a viewing direction, said apparatus comprising:

at least two power sources; and

a circuit responsive to the at least two power sources and supplying electrical potentials to the row and column electrodes according to periodic addressing cycles of the liquid crystal display, to cause the display to display desired images, wherein at least one of the electrical potentials supplied to the row and column electrodes changes with a voltage supplied or caused to be supplied by one of the power sources and said change of said at least one of the electrical potentials occurs in a predetermined timing relationship to the addressing cycles.